UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POST-CONSTRUCTION PERFORMANCE
EVALUATION REPORT – YEAR 8 (2000)

ANDALUSIA REFUGE HABITAT REHABILITATION AND ENHANCEMENT

JUNE 2001

US Army Corps
of Engineers
Rock Island District

POOL 16
MISSISSIPPI RIVER MILES 462.0 – 463.0
ROCK ISLAND COUNTY, ILLINOIS

CEMVR

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Many individuals of the Rock Island District, United States Army Corps of Engineers; the United States Fish and Wildlife Service; and the Illinois Department of Natural Resources contributed to the development of this Post-Construction Performance Evaluation Report for the Andalusia Refuge Habitat Rehabilitation and Enhancement Project. These individuals are listed below:

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EXECUTIVE SUMMARY

1. General. As stated in the Definite Project Report, the Andalusia Refuge project was initiated in response to limited management capability in providing quality habitat for waterfowl due to a lack of water level control. In the refuge south of Dead Slough, little or no water was present during the fall waterfowl migration. Sediments from the Mississippi River and adjacent uplands were decreasing the water volume in the refuge and backwater fisheries. This reduced water volume caused a succession from a dominance of aquatic bed palustrine wetlands to a more emergent plant species as well as decreasing deepwater fish habitat off the main channel.

2. Purpose. The purpose of this report is to provide a summary of the monitoring data and field observations, as well as project operation and maintenance, since completion of the last Performance Evaluation Report in August 1997.

3. Project Goals, Objectives, and Features. The two goals and associated objectives for the Andalusia Refuge project are as follows:

a. Enhance Migratory Waterfowl Habitat

(1) Increase reliable food production area (moist soil species) through water control provisions

(2) Increase reliable resting and feeding water area through mechanical dredging

b. Enhance Aquatic Habitat

(1) Restore deep aquatic habitat through mechanical dredging

(2) Restore lentic-lotic habitat access cross-sectional area through mechanical dredging

(3) Improve dissolved oxygen concentration during critical stress periods through mechanical dredging and gated inlet structure construction

(4) Reduce sedimentation in refuge through levee construction and tributary diversion

4. Observations and Conclusions. For the evaluation period of June 1997 to December 2000, the objectives to meet each goal had the following observations and conclusions.

a. Enhance Migratory Waterfowl Habitat

(1) <u>Increase Reliable Food Production Area (moist soil species)</u>

(a) Year 50 Target is to maintain a reliable food production area (moist soil species) greater than or equal to 130 acres

(b) Based on results from the 1997 PER, Year 4 (1996) reported 40 acres of reliable food production area

(c) Additional sedimentation transects should be accomplished in Year 9 (2001) to reevaluate this objective

(d) Field observations and vegetation surveys within the MSMU indicate good progress toward meeting the Year 50 Target acreage for moist-soil production

(2) Increase Reliable Resting and Feeding Water Area

(a) Year 50 Target is to maintain a reliable resting and feeding water area greater than or equal to 50 acres
(b) Based on results from the 1997 PER, Year 4 (1996) reported 49.3 acres of resting and feeding water area
(c) Additional sedimentation transects should be accomplished in Year 9 (2001) to reevaluate this objective
(d) Field observations of the project area suggest an increased use by wood ducks and provide evidence of a positive response by waterfowl

b. Enhance Aquatic Habitat

(1) Restore Deep Aquatic Habitat

(a) Year 50 Target is to maintain greater than or equal to 40 acre-feet of deep aquatic habitat (depth $\geq$ 6') in Dead Slough
(b) Based on water quality data in lieu of sedimentation transects, Year 8 (2000) reported an average water depth of 4.95 feet
(c) Sedimentation transects according to the monitoring plan will more accurately access sediment deposition and allow determination of deep aquatic habitat in acre-feet
(d) Additional sedimentation transects should be accomplished in Year 9 (2001) to fully evaluate this objective
(e) While the deep aquatic habitat has fallen below the ideal depth of 6 feet, the sedimentation rates have appeared to decreased substantially from an average rate of 7.28 inches per year in Year 6 (1998) to 0.36 inches per year in Year 8 (2000)

(2) Restore Lentic-Lotic Habitat Access Cross-Sectional Area

(a) Year 50 Target is to maintain a lentic-lotic habitat access cross-sectional area (depth $\geq$ 2') greater than or equal to 180 square feet
(b) Based on water quality data in lieu of sedimentation transects, Year 8 (2000) reported an average water depth of 3.5 feet
(c) Sedimentation transects according to the monitoring plan will more accurately access sediment deposition and allow determination of lentic-lotic habitat access in square feet
(d) Additional sedimentation transects should be accomplished in Year 9 (2001) to fully evaluate this objective
(e) Due to high sedimentation rates, a hydraulic study was conducted in 1997 – the recommendations were incorporated in 1998, which consisted of flattening the access channel slopes and planting vegetation in combination with dredging

(f) Sediment probes were installed within the access channel and Scisco Chute in 1999 – these probes are still collecting data
(g) Continued dredging of the access channel seems likely to maintain adequate depths for lentic-lotic habitat

(3) Improve Dissolved Oxygen Concentrations During Critical Stress Periods
(a) Year 50 Target is to maintain a DO concentration greater than or equal to 4 milligrams per Liter
(b) Based on water quality data, Year 8 (2000) reported a minimum, maximum, and average DO concentration of 3.86, 25.99, and 9.96 milligrams per Liter, respectively
(c) During the monitoring period of June 1997 to September 2000, the DO concentration fell below 4 milligrams per Liter one time out of 41 samples in August 1998
(d) According to the ILDNR, no fish kills were reported during the monitoring period

(4) Reduce Sedimentation in Refuge
(a) Year 50 Target is to maintain less than 4.2 acre-feet per year of sedimentation in the refuge
(b) Based on water quality data in lieu of sedimentation transects, Year 8 (2000) reported an average rate of 1.5 acre-feet per year
(c) Sedimentation transects according to the monitoring plan will more accurately access sediment deposition
(d) Additional sedimentation transects should be accomplished in Year 9 (2001) to fully evaluate this objective
(e) Refuge sedimentation rates have appeared to decreased substantially from an average rate of 30.3 acre-feet per year in Year 6 (1998) to 1.5 acre-feet per year in Year 8 (2000)

5. Conclusions and Recommendations. Data and observations collected since the last PER suggest that the goals and objectives evaluated for Andalusia Refuge project are being met (see Table 8-1). Further data collection should better define sedimentation rates and project utilization by migratory waterfowl and other wildlife.

Monitoring efforts for the Andalusia Refuge project have been performed according to the Post-Construction Performance Evaluation Plan in Appendix B and the Resource Monitoring and Data Collection Summary in Appendix C. The next PER will be an abbreviated report completed in March of 2002 following collection of field data from January 1, 2001 through December 31, 2001.

Project O&M for the Andalusia Refuge project has been conducted in accordance with the O&M Manual. There are no operational requirements attached to this project. The maintenance of project features has been adequate. Annual project inspections by the ILDNR Site Manager have resulted in proper corrective maintenance actions.

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POOL 16, MISSISSIPPI RIVER MILES 462.0 - 463.0
ROCK ISLAND COUNTY, ILLINOIS

1. INTRODUCTION

The Andalusia Refuge Habitat Rehabilitation and Enhancement Project (HREP), hereafter referred to as the "Andalusia Refuge project," is a part of the Upper Mississippi River System (UMRS) Environmental Management Program (EMP). The Andalusia Refuge project is located in Pool 16 on the Illinois side of the Mississippi River navigation channel between River Miles (RM) 462.0 and 463.0. Plate 1 in Appendix M contains a site plan and vicinity map. The Andalusia Refuge project is operated and maintained by the Illinois Department of Natural Resources (ILDNR) under the terms of a Cooperative Agreement with the United States Fish and Wildlife Service (USFWS).

a. Purpose. The purposes of this Performance Evaluation Report (PER) are as follows:

(1) Supplement monitoring results and project operation and maintenance discussed in the March 1997 Post-Construction PER;

(2) Summarize the performance of the Andalusia Refuge project, based on the project goals and objectives;

(3) Review the monitoring plan for possible revision;

(4) Summarize project operation and maintenance efforts to date; and

(5) Review engineering performance criteria to aid in the design of future HREP projects.

b. Scope. This report summarizes available project monitoring data, inspection records, and field observations made by the United States Army Corps of Engineers (Corps), the USFWS, and the ILDNR for the period from June 18, 1997 through December 31, 2000.

2. PROJECT GOALS AND OBJECTIVES

a. General. As stated in the Definite Project Report (DPR), the Andalusia Refuge project was initiated in response to limited management capability in providing quality habitat for waterfowl due to a lack of water level control. In the refuge south of Dead Slough, little or no water was present during the fall waterfowl migration. Sediments from the Mississippi River and adjacent uplands were decreasing the water volume in the refuge and backwater fisheries. This reduced water volume caused a succession from a dominance of aquatic bed palustrine wetlands to a more emergent plant species as well as decreasing deepwater fish habitat off the main channel.

b. Goals and Objectives. Goals and objectives, formulated during the project design phase, are summarized in Table 2-1.

TABLE 2-1
Project Goals and Objectives

Goals	Objectives	Project Features
Enhance Migratory Waterfowl Habitat	Increase reliable food production area (moist soil species)	Provide water control
	Increase reliable resting and feeding water area	Mechanical dredging
Enhance Aquatic Habitat	Restore deep aquatic habitat (Depth $\geq$ 6')	Mechanical dredging
	Restore lentic–lotic habitat access cross-sectional area	Mechanical dredging
	Improve dissolved oxygen concentration during critical stress periods	Mechanical dredging and gated inlet structure
	Reduce sedimentation in refuge	Construct levee and divert tributary

Table 2-1. Project Goals and Objectives

c. Management Plan. As with more recently developed EMP projects, a formal Annual Management Plan has been developed for the Andalusia Refuge project. This plan was developed by the Corps, in coordination with the ILDNR, as shown in Table 2-2. The Andalusia Refuge project is managed by the ILDNR under authority of Cooperative Agreements with the Corps and USFWS.

TABLE 2-2
Annual Management Plan

Month	Action	Purpose
May - July	Dewater Moist Soil Management Unit (MSMU) by pump station or gravity to the draw down elevation of 542 feet MSL [1/]	Expose mudflats to allow revegetation
August - November	Gradually increase MSMU water levels to correspond with growth of marsh plant community [2/]	Provide access to food plants for migratory waterfowl
December - April	Maintain MSMU water levels to maximum extent possible (elevation 547 feet MSL) primarily by use of pumping capability [3/]	Control excessive plant growth, if necessary, and provide stable, deeper water to prevent complete ice-up (a critical concern for resident furbearers)

Table 2-2. Annual Management Plan

[1/] Some adjustment shall be made to the drawdown elevation so that fisheries benefits are maximized without adversely impacting moist soil plant production

[2/] Elevations higher then 547 feet MSL must be coordinated with adjacent property owners during the non-crop season

[3/] Dewatering during February through April may be required to accomplish vegetation changes within the MSMU

Flat pool elevation is 545 feet MSL
Channel width is 40 feet
Channel elevation at Station 0+00 is 542 feet MSL. Slope is 0.0005
Channel elevation at water control structure (Station 5+40) is 541.73 feet MSL
Channel elevation at pump station (Station 50+00) is 536 feet MSL
Channel width parallel to levee at pump station is 20 to 40 feet
Ditch elevation at Station 49+45 is 539.67 feet MSL

3. PROJECT DESCRIPTION

a. Project Features. The Andalusia Refuge project consists of a moist soil management unit (MSMU), deep aquatic habitat, lentic-lotic access channel, diversion drainage ditch, and project access road. The project features can be seen on Appendix M, Plate 2, and are further discussed in the following paragraphs.

(1) Moist Soil Management Unit (MSMU). The main feature is the perimeter levee, constructed to protect the 130-acre MSMU. Other MSMU features include a pump station, water control structure, and interior / side drainage channels with associated islands.

(a) Perimeter Levee. The MSMU is surrounded by a 2-year precipitation event perimeter levee approximately 8,600 feet in length with a 12-foot crown (60-foot crown parallel to Dead Slough) and 4H:1V side slopes. The perimeter levee at the downstream end consists of a 600-foot long armored overflow section.

(b) Pump Station. The location of the pump station is near the downstream end of the perimeter levee. The pump station is equipped with two pumps which provide the capability to dewater the MSMU during draw down times and to add water from the Mississippi River into the MSMU if rainfall is insufficient to maintain desired water levels. The pump station was sized to evacuate the MSMU in approximately 14 days. However, actual performance exceeds design requirements. The pump station has dewatered the MSMU in about 7 to 10 days. The rated capacity of these pumps is 6,775 gallons per minute at a Total Dynamic Head (TDH) of 8.5 feet.

The pump station includes trash racks on both the MSMU and riversides. A sedimentation zone was provided on the MSMU side, which consists of an overflow weir protecting the entrance to the pump station to minimize the input of sediment during draw down periods.

The pump station includes an electrically driven 3-foot by 3-foot sluice gate to allow passage of gravity flows. This gate is used only when gravity discharge through the water control structure alone does not have sufficient capacity to drain the refuge as quickly as required, or when access to the water control structure is difficult due to wet conditions that would cause damage to the levee surface.

(c) Water Control Structure. The water control structure consists of a 36-inch diameter concrete conduit controlled by a 3-foot by 3-foot sluice gate, and is located within the perimeter levee section near the eastern edge of Dead Slough. The invert of the conduit is at elevation 542 feet MSL.

(d) Interior / Side Drainage Channels with Associated Islands. Interior drainage within the MSMU is provided through excavated fish access channels. Two types of typical sections were constructed. A Type I section consists of drainage channels constructed on both sides of an island. The excavated material produces an approximate 45-foot wide island with a top elevation of 551 feet MSL. A Type II section consists of a drainage channel constructed on one side of an island. The excavated

material produces an approximate 10-foot wide island with a top elevation of 551 feet MSL. The overall length of the refuge drainage channels is close to 8,600 feet.

The MSMU was designed to provide a reliable resting and feeding area for migrating waterfowl in existing open areas, as well as an additional food source within the inundated "green tree" portion of the unit.

(2) Deep Aquatic Habitat. The Contractor excavated approximately 85,000 cubic yards from Dead Slough for deep aquatic habitat improvement. Upon completion, a channel approximately 4,500 feet in length was excavated to 9 feet below flat pool (elevation 545 feet MSL) with an average bottom width of 60 feet. The excavated material was placed in the levee section adjacent to Dead Slough.

(3) Lentic-Lotic Access Channel. A 1,100-foot lentic-lotic access channel connects Scisco Chute to Dead Slough. Originally, the access channel was constructed to have a bottom width of approximately 30 feet with a depth that varied from 4 feet to 9 feet below flat pool (elevation 545 feet MSL). However, the access channel experienced greater than estimated sedimentation rates as a result of the Great Flood of 1993. It was subsequently re-excavated in March 1994 to 7 feet below flat pool (elevation 547 feet MSL) to approximate existing river bottom elevations.

(4) Diversion Drainage Ditch. Drainage from the watershed along the eastern edge of the project area is routed through the diversion drainage ditch to Scisco Chute. The bottom width of the excavated ditch is approximately 30 feet, with an average depth of 3 feet. The drainage ditch was sized to pass a 2-year precipitation event within the banks. The outlet of the diversion drainage ditch into Scisco Chute was placed near flat pool in order to reflect the previous drainage outlet and minimize maintenance.

The diversion drainage ditch was designed to reduce the present sediment load in the watershed by approximately 25 percent as discussed in the DPR, Appendix K. This reduction should improve the water quality in Dead Slough by reducing suspended solids and chemicals associated with agricultural runoff.

(5) Project Access Road. The approximately 3,600-foot long project access road follows the Government property line from the pump station to the county road just outside the project limits.

b. Project Construction. Following award of the construction contract on August 24, 1989, dredging began during late summer. Deep aquatic habitat excavation was finished in the summer of 1992. The Great Flood of 1993 caused minor erosion along the access road and some silting of the ditches. These areas were restored by contract modification. Excavation of the access channel to remove sediment deposited as a result of the Great Flood of 1993 was completed in March 1994 by the Corps labor forces. The Andalusia Refuge project was essentially complete in September 1994. A low water crossing to improve access road drainage and reduce sedimentation build-up was completed in August 1997.

c. Project Operation and Maintenance. Operation and maintenance (O&M) of the Andalusia Refuge project is the responsibility of the ILDNR in accordance with Section 107(b) of the Water Resources Development Act of 1992, Public Law 102-580. These functions are further defined in the O&M Manual. The project features were designed and constructed to minimize the operation and maintenance requirements. Project operation and maintenance generally consists of the following:

(1) Mowing and maintaining the perimeter levee to ensure serviceability during times of flood;

(2) Operating the pump station and water control structure to achieve desired water levels consistent with vegetative growth, and opening the gates to minimize overtopping erosion when the river reaches elevation 550 feet MSL on the Fairport gage with predicted stage to increase;

(3) Maintaining the interior / side drainage channels with associated islands as determined by the ILDNR Site Manager; and

(4) Removing snags and other debris from Dead Slough, the access channel, and the diversion drainage ditch.

4. PROJECT MONITORING

a. General. Appendix B presents the Post-Construction Evaluation Plan, along with the Sedimentation Transect Project Objectives Evaluation. These references were developed during the design phase and serve as a guide for measuring and documenting project performance. The Post-Construction Evaluation Plan also outlines the monitoring responsibilities for each agency. Appendix C contains the Monitoring and Performance Evaluation Matrix and Resource Monitoring and Data Collection Summary. The Monitoring and Performance Evaluation Matrix outlines the monitoring responsibilities for each agency. The Resource Monitoring and Data Collection Summary presents the types and frequency of data needed to meet the requirements of the Post-Construction Evaluation Plan. Plate 3 in Appendix M contains the monitoring plan for the Andalusia Refuge project.

b. U.S. Army Corps of Engineers. The success of the project relative to original project objectives shall be measured by the Corps, USFWS, and ILDNR through data collection and field observations. The Corps has overall responsibility to evaluate and document project performance.

The Corps is responsible for collecting field data as outlined in the Post-Construction Evaluation Plan at the specified time intervals. The Corps shall also perform joint inspections with the USFWS and ILDNR in accordance with ER 1130-2-339. The purpose of these inspections is to assure that adequate maintenance is being performed as presented in the DPR and O&M Manual. Joint inspections should also occur after any event that causes damage in excess of annual operation and maintenance costs.

c. U.S. Fish and Wildlife Service. The USFWS does not have project-specific monitoring responsibilities. However, the USFWS should be present at the joint inspections with the Corps and ILDNR as described in the previous paragraph.

d. Illinois Department of Natural Resources. The ILDNR is responsible for O&M, as well as monitoring the project through field observations during inspections. Project inspections should be performed on an annual basis following the guidance presented in the O&M Manual. It is recommended that the inspections be conducted in May or June, which is representative of conditions after spring floods. Joint inspections with the Corps and USFWS shall also be conducted as mentioned above. During all inspections, the ILDNR should complete the checklist form as provided in the O&M Manual. This form should also include a brief summary of the overall condition of the project and any maintenance work completed since the last inspection. Once completed, a copy of the form shall be sent to the Corps.

5. EVALUATION OF MIGRATORY WATERFOWL HABITAT OBJECTIVES

a. Increase Reliable Food Production Area.

(1) Monitoring Results. One of the objectives for enhancing migratory waterfowl habitat is to increase the reliable food production area through water level control. As shown in Appendix B, Table B-1, the Year 50 Target is to maintain more than 130 acres of reliable food production area (moist-soil species). Corps personnel conducted informal vegetation surveys on three occasions in 1996. A discussion of this data was included in the August 1997 PER. Since then, additional surveys have not been conducted. According to Table C-2 in Appendix C, informal vegetation surveys by the Corps are only required every five years.

In the August 1997 PER, field observations at several locations in the MSMU revealed good growth of moist-soil vegetation, particularly in the downstream portion of the project. Moist-soil plants representing four genera, namely 0pigweeds (*Amaranthus*), nutsedges (*Cyperus*), wild millet or barnyard grass (*Echinochloa*), and smartweeds (*Polygonum*), were observed in the drawdown areas of the MSMU.

To control encroachment of bulrush, lotus, and willow, the ILDNR Site Manager had the MSMU aerially sprayed in the spring of 1996. This was the last time the MSMU was treated in this manner. Field observations and examination of photographs taken during an aerial survey of the project in the fall of 1996 indicated that some remnants of this less desirable growth were still present in the upstream portion of the MSMU and on top of the islands. As a result, approximately half of the islands were burned in the spring of 1997 with the remaining islands burned in 1998 to once again attach the undesirable woody vegetation.

ILDNR personnel performed an inventory of moist-soil vegetation on August 28, 1996. Twenty-five plots (each 2 feet in size) were sampled to determine species composition, height, and percentage of ground coverage for each species present. A total of nine species occurred in sample plots (listed by percentage of occurrence); pigweed (68%), nutsedge (40%), bulrush – live (36%), bulrush – dead (36%), smartweed (32%), barnyard grass (28%), reed canary grass (12%), American lotus (8%), cattail (4%), and cucumber vine (4%). Pigweed was the most dominant species within the sampled plots, comprising 24.6% of the ground cover. Other dominant species included bulrush – dead (21.4%), bulrush – live (12.8%), and nutsedge (10.2%).

(2) Conclusions. Field observations and vegetation surveys within the MSMU in addition to corrective maintenance actions indicate good progress toward meeting the Year 50 Target acreage for moist-soil production. Water level control appears to be successful in promoting the growth of natural waterfowl food sources such as smartweeds, wild millet, pigweeds, and nutsedges. Continued management of the MSMU in accordance with the plan outlined in Table 2-2, in addition to burning and herbicide application as performed by the ILDNR Site Manager when necessary, should allow for the target acreage to be met in future years.

b. Increase Reliable Resting and Feeding Water Area.

(1) Monitoring Results. The other objective for enhancing migratory waterfowl habitat is to increase the reliable resting and feeding water area through mechanical dredging. As presented in the DPR, the Year 50 Target was to maintain 200 acres of reliable resting and feeding water area. This acreage was based on a MSMU configuration that included Dead Slough. However, this larger MSMU configuration was not implemented, as it would have greatly diminished fishery benefits gained from dredging Dead Slough. Therefore, the Year 50 Target was revised with an objective to maintain 50 acres of reliable resting and feeding area as shown in Appendix B, Table B-1. This acreage is the water surface area between sedimentation transects within the perimeter levee during the winter months when the MSMU is maintained at a maximum water elevation. Using sedimentation transects conducted in January 1997, the reliable resting and feeding water area was found to be 50 acres at an water elevation of approximately 547 feet MSL. A discussion of this revision was included in the August 1997 PER. Since then, additional transects have not been conducted. According Appendix C, Table C-2, sedimentation transects by the Corps are only required every five years.

Although willows within the MSMU were sprayed during construction, the inundation of the islands during flood events has not been sufficient to kill the willows that have started to take over since project completion. As mentioned earlier, the ILDNR Site Manager reported that approximately half of the islands were burned during the spring of 1997 to control the undesirable woody vegetation. Burning of the remaining islands was completed in the spring of 1998.

The ILDNR Site Manager has observed considerable waterfowl use in the downstream portion of the MSMU. Use of the project by wood ducks has been documented through checking of nest boxes installed in the refuge by ILDNR personnel. Of the 27 nest boxes inspected by the ILDNR Site Manager on March 8, 1996, 16 showed evidence of utilization by wood ducks. Subsequent visits to the nest boxes on January 31 and March 26, 1997, revealed evidence of wood duck use in 22 of the 26 available boxes.

(2) Conclusions. The Andalusia Refuge project appears to be meeting the objective of providing reliable resting and feeding water area. Future sedimentation transects or aerial photography should provide the data needed to determine the reliable resting and feeding area in acres. In turn, a better evaluation and discussion on this objective can be presented. Sedimentation transects inside the perimeter levee should be performed early in the year (January or February) when the MSMU is at increased water levels. The results of nest box checks during 1996 and 1997 suggest an increased use of the project area by wood ducks and provide evidence of a positive response to the project by waterfowl.

6. EVALUATION OF AQUATIC HABITAT OBJECTIVES

a. Restore Deep Aquatic Habitat (Depth ≥ 6').

(1) Monitoring Results. One of the objectives for enhancing aquatic habitat is to restore the deep aquatic habitat through mechanical dredging. As shown in Appendix B, Table B-1, the Year 50 Target is to maintain more than 40 acre-feet of deep aquatic habitat. Sedimentation transects for Dead Slough were conducted at project completion to reflect as-built conditions and again in 1996. A discussion of this data was included in the August 1997 PER. Since then, additional transects have not been conducted. According to Table C-2 in Appendix C, sedimentation transects by the Corps are only required every five years. However, during water quality monitoring, channel depths at both stations were recorded. Station W-M462.5O is located adjacent to sedimentation transect "C". This portion of the channel was designed to have an ideal water depth of greater than or equal to 6 feet at Year 50.

As seen in Table 6-1, Station W-M462.5O or transect "C" has an average flat pool depth of 4.95 feet at Year 8, which is less than the ideal water depth of 6 feet. The channel depths were determined by averaging those depths recorded during site visits from January 1998 to September 2000. To view individual channel depths for each site visit, refer to Table E-2 in Appendix E.

TABLE 6-1.
Restore Deep Aquatic Habitat

Year	W-M462.5O Flat Pool Depth (feet)	W-M462.5O Sedimentation Rate (in/yr)
0 (1992)	9.00	
0-6		7.28
6 (1998)	5.36	
6-7		4.56
7 (1999)	4.98	
7-8		0.36
8 (2000)	**4.95**	
0-8		6.08
50 (Target)	**6.00**	

Table 6-1. Restore Deep Aquatic Habitat

Sedimentation within the Andalusia Refuge project as stated in the DPR is due to the combination of two sources, namely the Mississippi River and adjacent uplands. Based on 1936 through 1987 data, the DPR estimated an overall average sedimentation rate for the entire area of 0.5 inches per year. The DPR estimate of the sedimentation rate in Dead Slough, or near Transect C, was greater than the estimated overall average. This rate was

estimated to be about 0.8 inches per year. In general, deep aquatic habitat depths in 1992 at project completion averaged 9 feet below flat pool. In 2000 or Year 8, deep aquatic habitat depths averaged 4.95 feet. This equates to an overall average sedimentation rate of 6.08 inches per year as shown in Table 6-1. It should also be noted that the average sedimentation rates from 1997 to 2000 steadily decreased from year to year. This may suggest that the slough is approaching a stable condition. From Year 7 to Year 8, the average sedimentation rate was approximately 0.36 inches per year. This value more closely resembles that determined in the DPR. In the future, if the average sedimentation rates remain fairly constant near the estimated values, it could be assumed that the slough has stabilized.

(2) Conclusions. It appears that the Andalusia Refuge project is not meeting the objective of restoring deep aquatic habitat by maintaining an average flat pool depth of greater than or equal to 6 feet. It could be assumed that these depths are representative of the entire project area but since the monitoring results were based solely on data collected at the water quality station, it is not known for sure if this is indeed the case. In addition, the location of the water quality station is determined through use of landmarks rather than coordinates, so channel depths are not necessarily recorded in the exact same spot each time. While the data from the water quality station may provide some idea of deep aquatic habitat depths, this is not its intended purpose. Therefore, future sedimentation transects based on the monitoring plan should result in more adequate data to better define deep aquatic habitat depths throughout the entire project area.

The design bottom elevation of 536 feet MSL for deep aquatic habitat was based on an ideal water depth of 6 feet, a low-flow regulation of 1 foot below flat pool, and sediment deposition of 2 feet over a project life of 50 years. The 2 feet of sediment accumulation is equivalent to an annual sedimentation rate of 0.5 inch per year. The average sedimentation rate was found to be approximately 6 inches per year. This higher sedimentation rate may be a result of the tendency of excavated channels to behave as sediment traps in the early years following construction or sloughing of the side slopes.

b. Restore Lentic-Lotic Habitat Access Cross-Sectional Area.

(1) Monitoring Results. Another objective of the enhancing aquatic habitat is to restore the lentic-lotic habitat access through mechanical dredging. As shown in Appendix B, Table B-1, the Year 50 Target is to maintain more than 180 square feet of lentic-lotic habitat access cross-sectional area. Sedimentation transects were conducted at project completion to reflect as-built conditions. In the 1993 Flood Damage Assessment Report, it was noted that the lentic-lotic habitat access channel had silted in considerably, from a post-construction range of elevation 536 through 541 feet MSL to 544 feet MSL in some places. In response to this report, the channel was re-excavated in March 1994 to elevation 538 feet MSL by Corps labor forces. In the August 1997 PER, the average elevation near the mouth of the channel was approximately 543 feet MSL. This elevation is only two feet below flat pool. It was determined that nearly 178 square feet of lentic-lotic habitat access cross-sectional area existed based on sedimentation transects, which is essentially the same as the Year 50 Target. Since then, additional transects have not been

completed. According to Appendix C, Table C-2, hydrographic soundings are only required every five years by the Corps.

However, a hydraulic study was conducted in October 1997 to determine the cause of the high sedimentation rate at the entrance to the lentic-lotic habitat access channel. The results of the study indicated that bank sloughing was the primary cause of excessive sedimentation near the channel entrance. Field reconnaissance revealed unstable banks with numerous slope failures. Existing bank slopes of 1H:1V and steeper were observed where the design slope was 2H:1V.

In addition, the 1997 hydraulic study proposed remedial solutions to alleviate the high sedimentation rate. In order to maintain an access depth of 3.5 feet, it was recommended that the bank slopes near the entrance to the lentic-lotic habitat access channel be graded to the design slope of 2H:1V (preferably 3H:1V) and then protected with vegetation. In addition, the access channel should be excavated to a depth of 3.5 feet below flat pool with the dredged material placed at least 50 feet beyond the crest of the downstream bank. Placement of dredged material on the downstream shore of Scisco Island was also stated as being acceptable. The other option was to relocate the access channel. The current entrance to the access channel is located near the downstream end of Scisco Island where sediment deposition is greatest. The lowest bottom elevation within Scisco Chute (elevation 536 feet MSL) is located approximately 2,400 feet upstream of the existing channel entrance. This would be the ideal location for the access channel. The report from this study is located in Appendix F.

In response to these recommendations, Corps labor forces excavated a portion of Scisco Chute and the access channel in 1998 to elevation 540 feet MSL or 5 feet below flat pool. Also, the banks were sloped back and vegetation was planted. After additional sediment deposition occurred, the access channel was visited in the summer of 1999. At this time, a second channel connecting the navigation channel to Dead Slough was discovered further downstream. More than likely, flow is entering Dead Slough through the access channel and exiting through the second channel. If this is the case, then the access channel is unable to naturally “flush” itself out.

In December 1999, six sediment probes were installed in Scisco Chute (Andalusia Slough) and the access channel to monitor conditions throughout the area. Currently, data is still being collected. Once this data is evaluated based on a hydraulic model that includes the second channel, available options for restoring or maintaining the channel shall be discussed with the ILDNR Site Manager. Recent conversations with operation and maintenance personnel at the Corps indicate that Scisco Chute has a depth of 3 to 4 feet. Table 6-2 summarizes the lentic-lotic habitat access channel depths observed since project completion.

(2) Conclusions. The Andalusia Refuge project is currently meeting the objective of restoring the lentic-lotic habitat access channel. Sufficient depth exists to permit fish access during the harshest of winters when ice cover would be anticipated to approach a thickness of 14 inches. Since the depths in the access channel have been

significantly low in the past, the remaining life of this objective is cause for concern and increased monitoring efforts are warranted. It could be assumed that the current depths in Scisco Chute are also representative of the lentic-lotic habitat access channel but it is not known for sure if this is indeed the case. Future sedimentation transects based on the monitoring plan in combination with data from the sediment probes should provide a lot more data to better define lentic-lotic habitat depths and sedimentation rates, respectively.

TABLE 6-2.
Restore Lentic-Lotic Habitat Access

Year	Access Channel Depth (feet)
0 (1992)	4.0 – 9.0
1 (1993)	1.0
2 (1994)	7.0
5 (1997)	2.0
6 (1998)	5.0
8 (2000)	**3.5**
50 (Target)	**2.0**

Table 6-2. Restore Lentic-Lotic Habitat Access

If the depth reaches 2 feet and remains at this point, it could be said that lentic-lotic habitat has been lost. Should this loss of depth occur, it would effectively isolate the project from the navigation channel, thus stranding fish during severe winter ice conditions. This point would represent the critical ending for the objective of providing lentic-lotic habitat access. By Year 8 (2000), this critical point has been reached and corrected on more than one occasion. Although lentic-lotic habitat access may diminish, the water areas shall continue to have significant long-term benefits for waterfowl and other wildlife, even with portions of the project maintaining depths greater than 2 feet.

c. Improve Dissolved Oxygen Concentration During Critical Stress Periods.

(1) Monitoring Results. The water quality objective of the Andalusia Refuge project is to improve dissolved oxygen (DO) concentrations in Dead Slough during critical stress periods. Critical stress periods often occur during the summer months when high temperatures are observed and during winter months when snow cover is maintained, causing DO concentrations to reach undesirable levels for fish habitat. The length of a stress period may last for only a few days. However, a low DO condition for a day or two may be enough to precipitate a fish kill. Fish kills are more likely to be observed in the

winter when ice cover may prevent fish from leaving the area experiencing a DO crash, whereas in the summer, there is a greater opportunity to escape.

As shown in Appendix B, Table B-1, the goal of the project is to maintain a DO concentration greater than or equal to 4 mg/L most of the time. Prior to project completion, local residents and the ILDNR reported severe summer and winter fish kills in Dead Slough. It is presumed these fish kills were due to low DO concentrations coupled with thermal stresses. In an effort to avoid future fish kills, dredging was utilized to create deep aquatic habitat within Dead Slough and an access channel from the slough to the Mississippi River.

Post-project water quality monitoring in Dead Slough has been ongoing since April 7, 1992 at Station W-M462.5O. This site is located in a dredged channel as shown in Appendix M, Plate 3. The initial post-evaluation report for this project covered the period April 7, 1992 through February 25, 1997. Reported herein are water quality data collected from June 18, 1997 through September 19, 2000. Data were obtained through a combination of periodic grab samples and the use of in-situ continuous monitors.

Grab samples were collected just below the surface on 41 occasions. The site was generally visited twice per month from June through September and monthly from December through March. Sampling was usually not performed during April, May, October and November. The following variables were typically measured: water depth, velocity, wave height, air and water temperature, cloud cover, wind speed and direction, DO, pH, total alkalinity, specific conductance, Secchi disk depth, turbidity, suspended solids, chlorophyll (a, b and c) and pheophytin a.

The results from periodic grab samples collected at Station W-M462.5O are found in Appendix E, Table E-1. The table includes the results from DO and ancillary parameters that are useful in the interpretation of DO data. DO concentrations ranged from 3.86 mg/L – 25.99 mg/L. Only one of the 41 DO measurements was below the 4 mg/L target level (3.86 mg/L on August 25, 1998). The average DO concentration (9.96 mg/L) at the site was more than twice the target value. All DO concentrations during the winter months were above the state standard; in fact, supersaturated conditions were observed on many occasions.

In-situ water quality monitors (YSI model 6000UPG or 6600UPG sondes) were deployed on 27 occasions. Sondes were positioned 3 feet above the bottom during most deployments. Deployments were typically for a period of two weeks during the summer months and four to five weeks during the winter months. The sondes were normally equipped to measure DO, temperature, pH, specific conductance, depth and turbidity.

In-situ continuous monitors were deployed at Station W-M462.5O on 27 occasions (6 during the winter months and 21 during the summer months). All winter DO concentrations were above the target level and supersaturated conditions were common. Figure E-1 in Appendix E is an example of DO and pH data collected during the winter with a continuous monitor. The graph depicts DO and pH values during the January 28

through February 25, 1999 deployment. Supersaturated DO conditions existed for approximately half the deployment period. The lowest DO concentration observed was 11.73 mg/L, while the highest value observed was 28.27 mg/L. In general, pH values paralleled DO concentrations. The lowest pH value observed was 7.80, while the highest value observed was 9.07. This relatively high value is most likely due to algal photosynthesis.

During the summer, nighttime DO concentrations often fell below the 4 mg/L target level; however, it was unusual for the DO concentration to stay below 4 mg/L for an extended period. Daytime DO concentrations usually exceeded 4 mg/L as a result of plant photosynthesis. Figure E-2 in Appendix E is an example of DO and pH data collected during the summer with a continuous monitor. The graph depicts DO and pH values during the June 22 through July 8, 1999 deployment. On occasion, the DO concentration fell below the 4 mg/L target level; however, these episodes were short lived. Again, pH values tended to parallel DO concentrations.

TABLE 6-3
Summary of Dissolved Oxygen Concentrations

Water Quality Station W-M462.5O	**Post-Project 4/7/92–2/25/97**	**Post-Project 6/18/97–9/19/00**
Total Number of Samples	42	41
Winter (October – March) Samples	17	10
Summer (April – September) Samples	25	31
DO Concentrations $\leq$ 4 mg/L	2 (4.8%)	1 (2.4%)
Winter DO Concentrations $\leq$ 4 mg/L	0	0
Summer DO Concentrations $\leq$ 4 mg/L	2 (8.0%)	1 (3.2%)
Minimum DO Concentration (mg/L)	3.04	3.86
Maximum DO Concentration (mg/L)	24.00	25.99
Average DO Concentration (mg/L)	10.69	9.96

Table 6-3. Summary of Dissolved Oxygen Concentrations

(2) Conclusions. The goal of the Andalusia Refuge EMP project is to maintain a DO concentration greater than or equal to 4 mg/L most of the time. The project was successful in attaining this goal during the June 18, 1997 through September 19, 2000 monitoring period. During the critical winter months, the DO concentration remained well above 4 mg/L. During the summer, DO concentrations commonly fell below 4 mg/L during the nighttime; however, daytime values were usually greater than 4 mg/L. Another indication of the project's success is the fact that several fish kills were reported prior to

project completion; however, according to Dan Sallee, fisheries biologist with the ILDNR, no fish kills were reported during the June 18, 1997 through September 19, 2000 monitoring period.

Essentially no pre-project water quality samples were collected from Station W-M462.5O because it was difficult to access. Comparisons of DO data from surface samples collected at Station W-M462.5O during the initial and current post-project evaluation periods are summarized in the Table 6-3.

Statistical comparisons between the two post-project periods show little change. The average DO concentration during the initial evaluation period (10.69 mg/L) was slightly greater than that observed during the current period (9.96 mg/L). This could be due to the higher percentage of samples collected during the winter months in the initial evaluation period.

d. Reduce Sedimentation in Refuge.

(1) Monitoring Results. The final objective for enhancing aquatic habitat is to reduce sedimentation in the refuge. As shown in Appendix B, Table B-1, the Year 50 Target is to maintain less than 4.2 acre-feet per year of sedimentation in the refuge. In order to achieve this objective, a drainage ditch was constructed to divert adjacent watershed erosion and sediment deposition around the Andalusia Refuge project to Scisco Chute. Although the MSMU is protected from a 2-year flood event by the perimeter levee, this project feature is not considered to contribute towards sediment reduction and therefore was not a factor when the target sedimentation rate was estimated. A sedimentation study conducted during the design phase, which is documented in the DPR, estimated a pre-project sedimentation rate of 17 acre-feet per year, with the navigation channel contributing 6 acre-feet per year and adjacent watersheds contributing 11 acre-feet per year. This estimated rate was based upon the sedimentation transects identified in Appendix B, Table B-2, sediment deposition of 1-inch per year, and a project area (Dead Slough and MSMU) of approximately 200 acres.

Sedimentation transects within the MSMU were conducted again after project completion to reflect as-built conditions and in 1996. Since then, additional transects have not been performed. According to Table C-2 in Appendix C, sedimentation transects are only required by the Corps every five years. However, it could be assumed that the sedimentation rates determined for Dead Slough (Table 6-1) are similar to those observed within the MSMU. In order to accomplish this task, the sedimentation rates were converted to acre-feet per year using a Dead Slough area of 150 acres. These rates were divided by three to determine the refuge sedimentation rates, since the MSMU is comprised of approximately 50 acres. The results are summarized in Table 6-4.

TABLE 6-4. Reduce Sedimentation in Refuge				
Year	**W-M462.5O Flat Pool Depth (feet)**	**W-M462.5O Sedimentation Rate (in/yr)**	**W-M462.5O Sedimentation Rate (ac-ft/yr)**	**Refuge Sedimentation Rate (ac-ft/yr)**
0 (1992)	9.00			
0-6		7.28	91.0	30.3
6 (1998)	5.36			
6-7		4.56	57.0	19.0
7 (1999)	4.98			
7-8		0.36	4.5	**1.5**
8 (2000)	4.95			
50 (Target)				**4.2**

Table 6-4. Reduce Sedimentation in Refuge

(2) Conclusions. The Andalusia Refuge project appears to be meeting the objective of reducing sedimentation in the refuge through construction of a diversion drainage ditch. The estimated sedimentation rate of 1.5 acre-feet per year from Year 7 to Year 8 is less than half of the Year 50 Target. Since it was assumed that the sedimentation rate observed in Dead Slough is representative of that within the MSMU, this estimated rate may not be correct. However, sediment deposition is anticipated to be greater in Dead Slough. In addition, the location of the water quality station is determined through use of landmarks rather than coordinates, so channel depths are not necessarily recorded in the exact same spot each time. While the data from the water quality station may provide some idea of deep aquatic habitat depths, it is not their intended purpose. Therefore, future sedimentation transects based on the monitoring plan should result in more adequate data to better define deep aquatic habitat depths throughout the entire project area.

7. OPERATION AND MAINTENANCE SUMMARY

a. Operation. Project operations are detailed in the O&M Manual. The Andalusia Refuge project has been operated successfully in this manner since completion. As described in the Annual Management Plan (Table 2-2), the MSMU is dewatered from May through July to expose mudflats and allow revegetation of moist-soil species. The MSMU water levels are gradually increased from August through November to correspond with the growth of the moist-soil species and to provide migratory waterfowl access to food. A high water level is maintained in the MSMU from December through April to control excessive plant growth and to prevent complete freeze out conditions.

In the past, landowners adjacent to the Andalusia Refuge project suggested that spring water levels in the MSMU interfered with the drainage on their land. According to the ILDNR Site Manager, there were not any complaints from adjacent landowners in 2000.

b. Maintenance.

(1) Inspections. A project inspection of the Andalusia Refuge project was performed in August 1997, June 1998, July 1999, and September 2000. The ILDNR Site Manager's project inspection and monitoring results for the dates mentioned above can be found in Appendix D. In addition, the Corps and ILDNR conducted a joint inspection of the Andalusia Refuge project in November 2000. At this time, the Corps completed a pump station inspection report, which is illustrated in Appendix G.

(2) Maintenance Based on Inspections. The pump station and ILDNR Site Manager's inspection reports are summarized below with respect to each project feature.

(a) Perimeter Levee. The ILDNR's project inspection reports noted that the perimeter levee had been mowed in June 1997, July 1998, June 1999, May 2000, July 2000, and September 2000. At the joint inspection in November 2000, the ILDNR Site Manager stated that the perimeter levee is typically mowed three to four times per year. A comment was made on settlement of the perimeter levee due to burrowing animals in the 1997 report. During the joint inspection, the ILDNR Site Manager remarked that burrowing animals were not an issue anymore since they began trapping last year.

In addition to burrowing animals, settlement of the perimeter levee caused by unauthorized vehicle use, namely ATVs and snowmobiles, was a concern in all reports. The 1997 and 1998 reports mentioned areas along the perimeter levee where scouring and overtopping erosion during flood events had occurred and caused the surface to be uneven. These problems appeared to have been corrected in viewing the perimeter levee last November. The condition of the levee as observed during the joint inspection can be seen in Appendix H. Overall, the levee was rated as acceptable. The only item rated marginally acceptable was "encroachment", where it was suggested that a 10-foot buffer zone be maintained between the toe of the levee and the tree line.

The 1997 and 1998 reports noted that woody vegetation in the riprap on both sides of the perimeter levee at the pump station was thick. According to the 1999 report, this vegetation was removed and the riprap was sprayed with Round-Up. These actions were repeated in the summer of 2000.

(b) Water Control Structure. In all three reports, it was noted that riprap was missing in various areas at the water control structure. However, it was also stated in these reports that so far it had not resulted in a problem. The inlet gate was repaired in 1999.

(c) Dead Slough Excavation. During inspection of the area in and around Dead Slough, it was noted in the 1997 report that a tree was down in the channel. However, the next year reports this same area to be clear of debris. Also in 1998, the Corps reshaped a portion of the bank surrounding Dead Slough.

(d) Refuge Drainage / Islands. In the MSMU, all three reports note an abundance of woody vegetation on several islands. In addition, the ILDNR Site Manager commented on the increase of cockleburs in the MSMU during the joint inspection in November. The MSMU was aerially sprayed by the ILDNR Site Manager in the spring of 1996 to control bulrush, lotus, and willow growth. This was the last time the MSMU was treated in this manner. Approximately half of the islands were burned in the spring of 1997 to control undesirable vegetation. The remaining islands were burned in 1998. In regards to unwanted debris, the 1997 report commented on a beaver dam that had started across the main channel. In the 1999 report, it was noted that the beaver dam was still there and had been completed. A continual problem in the MSMU is the erosion of the island banks.

(e) Pump Station. The 1997 report states that the fence systems at the pump station were not functioning as intended and were destroyed by ice, and that vegetative growth on the riverside of the levee had filled back in from shore to shore. The trash rack fence was designed for those years when there is an excess of floating or dead vegetation outside of the MSMU, river levels are low, and fall pumping is required. The ILDNR installed the outer perimeter fence for additional protection. In the 1998 and 1999 reports, it was noted that the outer perimeter fence still had not been repaired or removed. However, it is believed that this fence was indeed repaired in 1998 after Corps labor forces corrected a problem with the sluice gate. Annual maintenance should be performed on both fences prior to freezing conditions in the channel.

The pump station maintenance inspection guide gives an overall rating of the pump station. In this guide there are two sections. The first section is for internal use and evaluation while the second section is for local sponsor use. Within section one there is only one item to critique. In section two there are 15 items to critique. Each item has an evaluation and remarks column.

Overall, the pump station report passed with an acceptable rating. There was only one item that fell below the acceptable rating. This was item number 12 - Pump Control

System. This item was given a minimal acceptable rating. This means that the pump control system is operational but with minor discrepancies. Some general comments were included in the report as well. The first comment noticed gaskets detaching from the aluminum stoplogs. The second comment explained the problem the ILDNR Site Manager had while attempting to maintain the MSMU between elevation 543 and 543.5 feet MSL. The "pump out" pump could not be operated in the "manual" or "auto" mode. The cause of the operational flaw was not investigated nor corrected.

(f) Access Road. To remedy an area of poor drainage along the access road, the Corps constructed a low water crossing in July 1997. This contract also consisted of removing debris and reshaping the ditches along the access road, as well as repairing the culverts. New gravel was placed along the access road and at the pump station. In addition, the dredged material placement site was cleaned and reshaped.

8. CONCLUSIONS AND RECOMMENDATIONS

a. Project Goals, Objectives, and Management Plan. Data and observations collected since the last PER suggest that the goals and objectives evaluated for Andalusia Refuge project are being met, as illustrated in Table 8-1. Further data collection should better define sedimentation rates and project utilization by migratory waterfowl and other wildlife.

TABLE 8-1
Project Goals and Objectives

Goals	Objectives	Project Features	Unit	Year 8 (2000)	Year 50 (2042) Target	Status
Enhance Migratory Waterfowl Habitat	Increase reliable food production area (moist soil species)	Provide water control	Acres	40 [1/]	130	Met
	Increase reliable resting and feeding water area	Mechanical dredging	Acres	49.3 [1/]	50	Met
Enhance Aquatic Habitat	Restore deep aquatic habitat (Depth $\geq$ 6')	Mechanical dredging	Ac-ft	34 [1/]	40	Not Met
	Restore lentic–lotic habitat access cross-sectional area	Mechanical dredging	Ft^2	177.5 [1/]	180	Met
	Improve dissolved oxygen concentration during critical stress periods	Mechanical dredging and gated inlet structure	Mg/L (min) (max) (ave)	3.86 25.99 9.96	4	Met
	Reduce sedimentation in refuge	Construct levee & divert tributary	Ac-ft / year	1.5	4.2	Met

Table 8-1. Project Goals and Objectives
[1/] This number reflects that summarized in the 1997 PER since sedimentation transects are only required every five years – the next round of transects should be completed in 2001

b. Post-Construction Evaluation and Monitoring Schedules. Monitoring efforts for the Andalusia Refuge project have been performed according to the Post-Construction Performance Evaluation Plan in Appendix B and the Resource Monitoring and Data Collection Summary in Appendix C. The next PER will be an abbreviated report

completed in March of 2002 following collection of field data from January 1, 2001 through December 31, 2001.

For this PER only, a revised table was developed in order to quantify and evaluate certain project objectives. Since additional sediment transects have not been completed, the restore deep aquatic habitat objective was evaluated based on depth in feet rather than area in acre-feet. As a result, the "Unit" and "Year 50 Target" columns were modified. This objective and its modified performance parameters are highlighted in Table 8-2.

TABLE 8-2
Project Goals and Objectives (revised for this PER only)

Goals	Objectives	Project Features	Unit	Year 8 (2000)	Year 50 (2042) Target	Status
Enhance Migratory Waterfowl Habitat	Increase reliable food production area (moist soil species)	Provide water control	Acres	40 [1/]	130	Met
	Increase reliable resting and feeding water area	Mechanical dredging	Acres	49.3 [1/]	50	Met
Enhance Aquatic Habitat	Restore deep aquatic habitat (Depth $\geq$ 6')	Mechanical dredging	**Feet**	4.95	**6**	Not Met
	Restore lentic–lotic habitat access cross-sectional area	Mechanical dredging	**Feet**	3.5	**2**	Met
	Improve dissolved oxygen concentration during critical stress periods	Mechanical dredging and gated inlet structure	Mg/L (min) (max) (aver)	3.86 25.99 9.96	4	Met
	Reduce sedimentation in refuge	Construct levee & divert tributary	Ac-ft year	1.5	4.2	Met

Table 8-2. Project Goals and Objectives (revised for this PER only)
[1/] This number reflects that summarized in the 1997 PER since sedimentation transects are only required every five years – the next round of transects should be completed in 2001

(1) Increase reliable food production area (moist-soil species). Earlier evaluations have indicated project success in promoting moist-soil species and increasing the natural waterfowl food production. Some active measures, such as burning or

herbicide application, should be continued to control encroachment of less desirable plant species within the MSMU to meet the Year 50 Target acreage. In the future, this acreage should be revised based on a more accurate quantification of the maximum potential food production area within the MSMU if the opportunity arises. Formal vegetation transects were not established within the MSMU prior to project completion and are not included in the Post-Construction Evaluation Plan. Informal vegetation surveys by Corps personnel and field observations by the ILDNR Site Manager shall be utilized to monitor performance of reliable food production area.

(2) Restore Deep Aquatic Habitat and Reduce Sedimentation in Refuge. It is not only apparent for the Andalusia Refuge project but for other HREP projects as well that the annual sedimentation rates are consistently underestimated. This may be due to the fact that many of the existing HREP projects are still in the younger years of their design life and that sediment deposition is not linear, but rather logarithmic. The result is higher sedimentation rates in the earlier years of the project until the channel becomes stabilized and sedimentation rates begin to level off. If this is indeed the case, then it seems practical to conduct sedimentation transects on a similar scale. Transects should be performed more frequently in the first ten years and less often in later years. This in turn would closely follow the implementation schedule for PERs. More importantly, a better relationship between sedimentation rates versus project life could be determined and incorporated in the design of future HREP projects.

HREP design, evaluation, and measurement of project features have evolved since the EMP program began. Measuring acre-feet of deep aquatic habitat, acre-feet per year of sedimentation, or cross-sectional area of lentic-lotic habitat access, are objectives easily calculated during design. However, after project completion, these objectives may not provide the necessary information for a proper evaluation. For example, dredged or excavated channel side slopes may have sloughed, thus widening the channel and decreasing depth, but the cross-sectional area may not reflect this loss of depth. As a result, the flat pool depth may be inadequate to support deep aquatic habitat when the cross-sectional area shows the objective being met. Perhaps simpler measurements coupled with biological monitoring are warranted. For aquatic habitat, this may simply be depth in combination with fish surveys. Younger HREP projects are incorporating this idea by utilizing electrofishing as a feature measurement.

(3) Restore Lentic-Lotic Habitat Access Cross-Sectional Area. Scisco Chute and the lentic-lotic habitat access channel have experienced excessive sediment deposition since project completion. The flat pool depths in access channel may be approaching the critical point of 2 feet, which would no longer meet the criteria for lentic-lotic habitat. Therefore, the remaining life of this objective is cause for concern. It is recommended that sedimentation transects based on the monitoring plan in combination with an evaluation of data from the sediment probes be conducted during the next performance period to better define habitat depths and sedimentation rates in the channel. In order to meet the Year 50 Target for lentic-lotic habitat access, continual dredging of the channel seems likely in the future.

c. Project Operation and Maintenance. Project operation and maintenance for the Andalusia Refuge project has been conducted in accordance with the O&M Manual. There are no operational requirements attached to this project. The maintenance of project features has been adequate. Annual project inspections by the ILDNR Site Manager have resulted in proper corrective maintenance actions.

d. Project Design Enhancement. Discussions with those involved with operation, maintenance, and monitoring activities at the Andalusia Refuge project have resulted in the following general conclusions regarding project features that may affect future HREP project design:

The primary dredging project design and evaluation criteria in apparent need of review is project feature life expectancy. For this project, a 50-year life does not appear to be a realistic restoration goal. A programmatic review of engineering design criteria for a 50-year project life and sponsor O&M requirements for constructed features should be accomplished. Additionally, future PERs should consider O&M expenditures versus estimated costs. Program reauthorization might consider the ability to return to a project post-construction and fund additional work to simplify or correct O&M difficulties. The benefits of restoring habitat through maintenance activities and the habitat disruptions that may accompany such activities need to be assessed on a project-by-project basis.

APPENDIX A

ACRONYMS

ACRONYMS

CEMVR	Corps of Engineers, Mississippi Valley Division, Rock Island District
DO	Dissolved Oxygen
DPR	Definite Project Report
EMP	Environmental Management Program
ER	Engineer Regulation
HREP	Habitat Rehabilitation and Enhancement Project
ILDNR	Illinois Department of Natural Resources
LTRMP	Long-Term Resource Monitoring Program
MSL	Mean Sea Level
MSMU	Moist Soil Management Unit
O&M	Operation and Maintenance
PER	Performance Evaluation Report
RM	River Mile
TDH	Total Dynamic Head
UMRS	Upper Mississippi River System
USFWS	United States Fish and Wildlife Service

APPENDIX B

POST-CONSTRUCTION EVALUATION PLAN
AND
SEDIMENTATION TRANSECT PROJECT OBJECTIVES EVALUATION

TABLE B-1
Post-Construction Evaluation Plan

Goal	Objective	Enhancement Feature	Unit	Year 0 (1992) Without Project	Year 0 (1992) With Project	Year 8 (2000) With Project	Year 50 (2042) Target With Project	Feature Measurement	Annual Field Observations by ILDNR Site Manager
Enhance Migratory Waterfowl Habitat	Increase reliable food production area (moist soil species)	Provide water control	Acres	0	--	40 [1/]	130	Informal vegetation surveys	Development of emergent vegetation
	Increase reliable resting & feeding water area	Mechanical dredging	Acres	0	--	49.3 [1/]	50	Perform hydrographic soundings of transects	Waterfowl presence or absence
Enhance Aquatic Habitat	Restore deep aquatic habitat (Depth $\geq$ 6')	Mechanical dredging	Ac-ft	0	55.8	34 [1/]	40	Perform hydrographic soundings of transects	Development of emergent vegetation within deep dredged are
	Restore lentic-lotic habitat access cross-sectional area	Mechanical dredging	Ft^2	0	308	177.5 [1/]	180	Perform hydrographic soundings of transects	Development of emergent vegetation within access area
	Improve dissolved oxygen concentration during critical stress periods	Mechanical dredging & gated inlet structure	Mg/L (min) (max) (aver)	< 4	> 4	3.86 25.99 9.96	4	Perform water quality testing at stations	Fish stress or fish kills
	Reduce sedimentation in refuge	Construct levee & divert tributary	Ac-ft / year	11	--	1.5	4.2	Perform hydrographic soundings of transects	Shoaling in shallows areas

Table B-1. Post-Construction Evaluation Plan

[1/] This number reflects that summarized in the 1997 PER since sedimentation transects are only required every five years – the next round of transects should be completed in 2001

TABLE B-2
Sedimentation Transect Project Objectives Evaluation

Transect	Project Objectives to Be Evaluated			
	Increase Reliable Resting & Feeding Water Area	**Restore Deep Aquatic Habitat**	**Restore Lentic-Lotic Habitat Access Cross-Sectional Area**	**Reduce Sedimentation in Refuge**
Dead Slough				
A	X	X		X
C	X	X		X
D [1/]			X	
D1 [1/]			X	
D2 [1/]			X	
E	X	X		X
I	X			X
K	X			X
L [2/]				
M [2/]				
P [2/]				

Table B-2. Sedimentation Transect Project Objectives Evaluation

[1/] Transects added during post-construction phase

[2/] Transects undisturbed by project construction

APPENDIX C

MONITORING AND PERFORMANCE EVALUATION MATRIX
AND
RESOURCE MONITORING AND DATA COLLECTION SUMMARY

TABLE C-1
Monitoring and Performance Evaluation Matrix

Project Phase	Type of Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Implementation Instructions
Pre-Project	Sedimentation Problem Analysis	System-wide problem definition; evaluates planning assumptions	USGS	USGS	LTRMP	--
	Pre-Project Monitoring	Identifies and defines problems at HREP site; establishes need of proposed project features	USFWS	USFWS	USFWS	--
	Baseline Monitoring	Establishes baselines for performance evaluation	Corps	Corps	HREP	See Table C-2
Design	Data Collection for Design	Includes quantification of project objectives, design of project, and development of performance evaluation plan	Corps	Corps	HREP	See Table C-2
Construction	Construction Monitoring	Assesses construction impacts; assures permit conditions are met	Corps	Corps	HREP	See State Section 401 Stipulations
Post-Construction	Performance Evaluation Monitoring	Determines success of project as related to objectives	Corps / ILDNR	Corps / ILDNR	HREP	See Table C-2
	Analysis of Biological Responses to Projects	Evaluates predictions and assumptions of habitat unit analysis; studies beyond scope of performance evaluation, or if projects do not have desired biological results	Corps	Corps	HREP	--

able C-1. Monitoring and Performance Evaluation Matrix

TABLE C-2
Resource Monitoring and Data Collection Summary [1/]

e surement	Water Quality Data						Engineering Data			Natural Resource Data			Sampling Agency	Remarks
	Pre-Project Phase		Design Phase		Post-Const Phase		Pre-Project Phase	Design Phase	Post-Const Phase	Pre-Project Phase	Design Phase	Post-Const Phase		
	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Jun-Sep	Dec-Mar								
NT MEASUREMENTS														
er Quality Stations [2/]													Corps	
rbidity					2W	M								
cchi Disk Transparency	2W				2W	M								
spended Solids	2W				2W	M								
ssolved Oxygen	2W				2W	M								
ecific Conductance	2W				2W	M								
ter Temperature	2W				2W	M								
	2W				2W	M								
tal Alkalinity					2W	M								
lorophyll	2W				2W	M								
locity					2W	M								
ter Depth	2W				2W	M								
ter Elevation	2W				2W	M								
rcent Ice Cover						M								
Depth						M								
rcent Snow Cover						M								
ow Depth						M								
nd Direction					2W	M								
nd Velocity					2W	M								
ve Height					2W	M								
Temperature					2W	M								
rcent Cloud Cover					2W	M								
ment Test Stations [3/]													Corps	
lk Sediment			1											
triate			1											
ain Size			1											
ng Stations													Corps	
otechnical Borings [4/]								1						
lumn Settling Analysis [5/]								1						

TABLE C-2 (Continued)
Resource Monitoring and Data Collection Summary [1/]

e Measurement	Water Quality Data						Engineering Data			Natural Resource Data			Sampling Agency	Remarks
	Pre-Project Phase		Design Phase		Post-Const Phase		Pre-Project Phase	Design Phase	Post-Const Phase	Pre-Project Phase	Design Phase	Post-Const Phase		
	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Jun-Sep	Dec-Mar								
NT MEASUREMENTS ntinued)														
erfowl Numbers													ILDNR	
rial Survey												Y		
Stations													ILDNR	
ctrofishing / Netting												M		
NSECT MEASUREMENTS														
mentation Transects [6/]													Corps	
drographic Soundings							1		5Y					
etation Transects													Corps	
ist Soil Plant Survey												5Y		
A MEASUREMENTS														
ping [7/]													Corps	
rial Photos / Remote Sensing										1		5Y		

ble C-2. Resource Monitoring and Data Collection Summary

= Weekly
Monthly
Yearly
= n-Weekly interval
= n-Yearly interval
,3, --- = number of times data is collected within designated project phase

TABLE C-2 (Continued)
Resource Monitoring and Data Collection Summary [1/]

[1/] Resource Monitoring and Data Collection Summary - See Plate 3 in Appendix M for Monitoring Plan

[2/] Water Quality Stations

W-M462.5O

[3/] Sediment Test Stations (Design Phase)

DPR-R-1	DPR-L-1
DPR-R-2	DPR-L-2
DPR-R-3	DPR-L-3

[4/] Boring Stations (Design Phase)

DPR-A-87-1	DPR-A-87-8
DPR-A-87-2	DPR-A-87-9
DPR-A-87-3	DPR-A-87-10
DPR-A-87-4	DPR-A-87-11
DPR-A-87-5	DPR-A-87-12
DPR-A-87-6	DPR-A-87-13
DPR-A-87-7	DPR-A-87-14

[5/] Column Settling Stations (Design Phase)

(50# Settlement Analysis)
DPR-Sample 1
DPR-Sample 2

[6/] Sedimentation Transects

PER	O&M Manual	DPR
A	S-M462.6X to S-M462.9Q	Range A
C	S-M462.5U to S-M462.8L	Range C
D	None	None
D1	None	None
D2	None	None
E	S-M462.3U to S-M462.5M	Range E
I	S-M462.1W to S-M462.2N	Range I
K	S-M462.0Q to S-M462.1N	Range K
L	S-M461.8O to S-M461.8V	Range L
M	S-M461.7X to S-M461.7O	Range M
P	S-M461.3Y to S-M461.2S	Range P

[7/] Mapping (Post-Construction Phase) – aerial survey shall be performed of the project area to determine the amount of water fowl resting and feeding in project water areas

July 12, 1993 – color aerial photos (1” = 1000’)
April 17, 1994 – color aerial photos (1” = 1000’)
November 21, 1995 – black & white photos (1” = 1400’)
November 24, 1995 – black & white photos (1” = 2800’)
September 26, 1996 – color oblique aerial photos

APPENDIX D

COOPERATING AGENCY CORRESPONDENCE

APPENDIX E

WATER QUALITY DATA

TABLE E-1.
Post-Project Monitoring Results at Station W-M462.5O

Date	Water Depth (m)	Velocity (ft/s)	Water Temp (°C)	DO (mg/L)	pH (SU)	Chlorophyll a (mg/m^3)
6/18/97	2.13	0.04	24.3	4.68	7.78	68.0
7/2/97	2.30	0.20	28.9	4.85	7.91	75.0
7/17/97	2.29	0.04	28.0	7.86	8.31	66.0
7/31/97	2.16	0.00	25.2	7.12	8.27	63.0
8/19/97	2.09	0.00	24.0	6.00	8.26	69.0
9/3/97	1.52	0.13	23.0	6.42	8.36	64.0
9/25/97	2.01	**	17.8	9.23	8.54	69.0
12/23/97	1.68	0.00	2.1	18.50	*	28.0
1/27/98	1.83	0.00	0.4	15.38	8.25	61.0
2/24/98	1.97	*	6.5	19.98	8.77	120.0
3/24/98	2.10	0.00	6.2	17.80	7.80	160.0
6/3/98	1.66	0.11	22.5	4.32	7.89	34.0
7/2/98	2.50	0.00	24.9	5.52	7.56	9.6
7/14/98	2.35	0.00	26.3	7.44	7.96	25.0
7/28/98	1.80	0.03	26.8	8.92	8.37	110.0
8/13/98	1.95	0.00	25.9	6.27	7.97	77.0
8/25/98	1.52	0.00	27.2	3.86	7.53	68.0
9/10/98	1.66	0.00	22.6	7.82	8.24	100.0
9/28/98	1.63	0.00	25.7	11.65	8.43	95.0
12/29/98	1.81	0.00	0.4	23.13	8.50	30.0
1/28/99	1.95	0.00	-0.1	13.00	7.80	2.6
2/25/99	1.72	0.00	1.9	25.99	8.80	97.0
3/23/99	1.58	0.00	7.2	22.20	8.70	140.0
5/27/99	3.35	0.85	17.5	7.73	7.24	16.0
6/22/99	1.74	0.07	22.8	6.50	7.90	15.0
7/8/99	1.71	0.00	27.4	7.08	8.30	34.0
7/27/99	1.98	0.00	28.7	5.11	7.90	53.0
8/10/99	1.77	0.08	24.7	7.70	8.40	120.0
8/24/99	1.89	0.00	22.3	6.54	8.40	100.0
9/8/99	1.65	0.00	23.6	6.60	8.30	78.0
9/21/99	1.50	0.00	17.3	8.72	8.50	100.0
2/8/00	1.58	0.00	0.2	15.22	7.90	17.0
3/7/00	1.81	0.04	10.5	14.90	8.40	67.0
5/31/00	1.73	0.00	19.6	7.40	8.00	17.0
6/15/00	3.10	-	20.4	4.59	7.60	7.8
7/6/00	1.79	-	22.7	4.01	7.60	7.0
7/25/00	1.71	-	24.6	11.86	8.50	88.0
8/8/00	1.72	-	28.8	17.06	8.80	23.0
8/22/00	1.66	-	23.5	7.43	8.20	83.0
9/5/00	1.52	-	22.1	5.20	7.80	52.0
9/19/00	1.70	-	20.8	6.88	8.10	48.0
MIN	1.50	0.00	-0.1	3.86	7.24	2.6
MAX	3.35	0.85	28.9	25.99	8.80	160.0
AVG	1.91	0.05	18.9	9.96	-	62.4

Table E-1. Post-Project Monitoring Results at Station W-M462.5O

FIGURE E-1. Post-Project Dissolved Oxygen and pH Values Collected with a Continuous Monitor at Station W-M462.5O

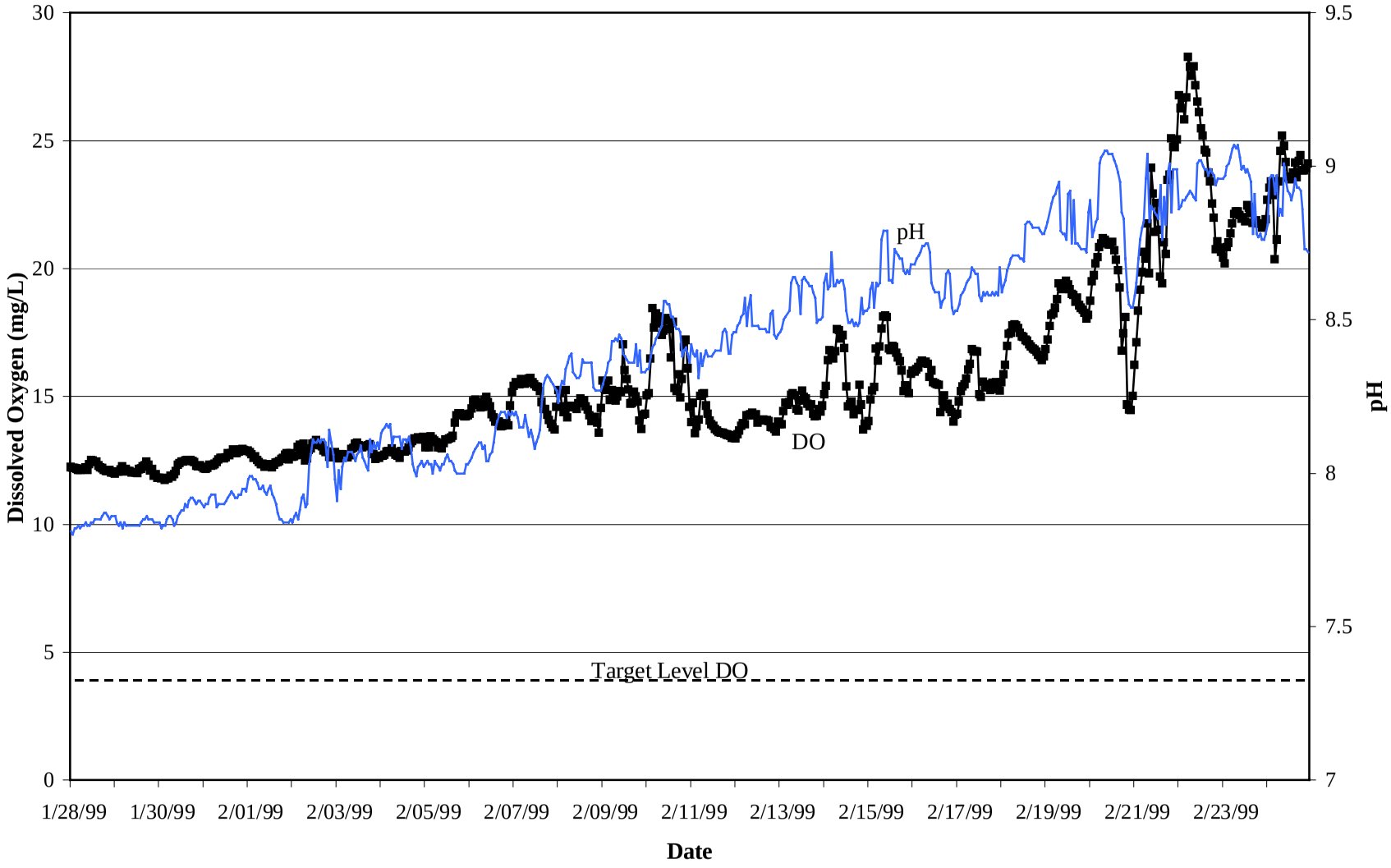

Figure E-1. Monitoring Results at Station W-M462.5O during Winter 1999

FIGURE E-2. Post-Project Dissolved Oxygen and pH Values Collected with a Continuous Monitor at Station W-M462.5O

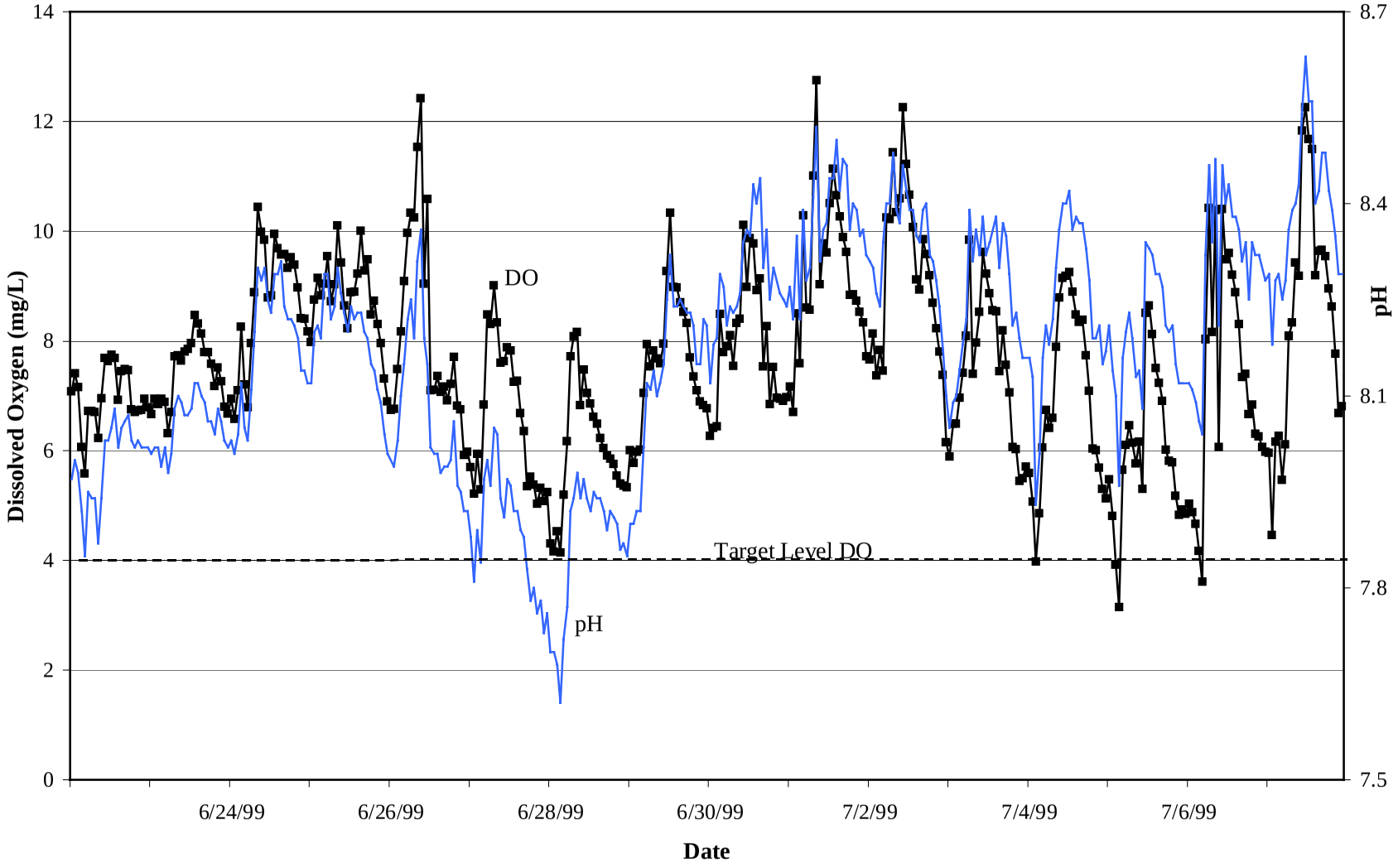

Figure E-2. Monitoring Results at Station W-M462.5O during Summer 1999

TABLE E-2.
Summary of Channel Depths at Station W-M462.5O

Date	W-M 462.5O Channel Depth (meters)	W-M 462.5O Channel Depth (feet)	FAII4 463.5 Gage Reading (feet)	FAII4 463.5 Pool Elevation (feet) [1/]	MI16 457.2 Gage Reading (feet)	MI16 457.2 Pool Elevation (feet) [2/]	W-M 462.5O Pool Elevation (feet)	W-M 462.5O Bottom Elevation (feet) [3/]	W-M 462.5O Flat Pool Depth (feet) [4/]
1/27/98	1.83	6.00	-	-	11.40	545.19	-	-	-
2/24/98	1.97	6.45	10.85	546.01	11.60	545.39	545.91	539.46	5.54
3/24/98	2.10	6.90	10.61	545.77	11.06	544.85	545.62	538.73	6.27
6/3/98	1.66	5.45	10.62	545.78	11.44	545.23	545.69	540.24	4.76
7/2/98	2.50	8.20	12.39	547.55	12.18	545.97	547.30	539.10	5.90
7/14/98	2.35	7.70	12.46	547.62	10.86	544.65	547.15	539.45	5.55
7/28/98	1.80	5.90	10.57	545.73	11.47	545.26	545.66	539.76	5.24
8/13/98	1.95	6.40	10.80	545.96	11.75	545.54	545.89	539.49	5.51
8/25/98	1.52	5.00	10.24	545.40	11.24	545.03	545.34	540.34	4.66
9/10/98	1.66	5.45	10.17	545.33	11.40	545.19	545.31	539.86	5.14
9/28/98	1.63	5.35	10.19	545.35	11.40	545.19	545.32	539.98	5.02
12/29/98	1.81	5.95	10.49	545.65	11.67	545.46	545.62	539.67	5.33
1/28/99	1.95	6.40	10.84	546.00	11.63	545.42	545.91	539.51	5.49
2/25/99	1.72	5.65	10.50	545.66	11.03	544.82	545.53	539.88	5.12
3/23/99	1.58	5.20	11.19	546.35	11.83	545.62	546.23	541.04	3.96
5/27/99	3.35	11.00	15.40	550.56	15.23	549.02	550.32	539.32	5.68
6/22/99	1.74	5.70	11.18	546.34	10.48	544.27	546.01	540.31	4.69
7/8/99	1.71	5.60	10.81	545.97	10.87	544.66	545.76	540.16	4.84
7/27/99	1.98	6.50	11.25	546.41	10.06	543.85	546.00	539.51	5.49
8/10/99	1.77	5.80	10.65	545.81	10.95	544.74	545.64	539.84	5.16
8/24/99	1.89	6.20	10.91	546.07	11.66	545.45	545.97	539.77	5.23
9/8/99	1.65	5.40	10.47	545.63	11.43	545.22	545.56	540.17	4.83
9/21/99	1.50	4.92	10.50	545.66	11.56	545.35	545.61	540.69	4.31
2/8/00	1.58	5.18	10.13	545.29	11.31	545.10	545.26	540.08	4.92
3/7/00	1.81	5.94	10.81	545.97	10.45	544.24	545.70	539.76	5.24
5/31/00	1.73	5.67	10.65	545.81	11.17	544.96	545.68	540.00	5.00
6/15/00	-	-	14.81	549.97	14.57	548.36	549.71	-	-
7/6/00	1.79	5.86	11.23	546.39	10.08	543.87	545.99	540.13	4.87
7/25/00	1.71	5.59	10.65	545.81	11.20	544.99	545.68	540.09	4.91
8/8/00	1.72	5.64	10.60	545.76	11.66	545.45	545.71	540.07	4.93
8/22/00	1.66	5.43	10.54	545.70	11.52	545.31	545.64	540.21	4.79
9/5/00	1.52	4.99	10.10	545.26	-	-	-	-	-
9/19/00	1.70	5.58	10.54	545.70	11.46	545.25	545.63	540.05	4.95

TABLE E-2. (Continued)
Summary of Channel Depths at Station W-M462.5O

Date	W-M 462.5O Channel Depth (meters)	W-M 462.5O Channel Depth (feet)	FAII4 463.5 Gage Reading (feet)	FAII4 463.5 Pool Elevation (feet) [1/]	MI16 457.2 Gage Reading (feet)	MI16 457.2 Pool Elevation (feet) [2/]	W-M 462.5O Pool Elevation (feet)	W-M 462.5O Bottom Elevation (feet) [3/]	W-M 462.5O Flat Pool Depth (feet) [4/]
98 MIN	1.52	5.00	10.17	545.33	10.86	544.65	545.31	538.73	4.66
98 MAX	2.50	8.20	12.46	547.62	12.18	545.97	547.30	540.34	6.27
98 AVG	1.90	6.23	10.85	546.01	11.46	545.25	545.89	539.64	5.36
99 MIN	1.50	4.92	10.47	545.63	10.06	543.85	545.53	539.32	3.96
99 MAX	3.35	11.00	15.40	550.56	15.23	549.02	550.32	541.04	5.68
99 AVG	1.89	6.21	11.25	546.41	11.52	545.31	546.23	540.02	4.98
00 MIN	1.52	4.99	10.10	545.26	10.08	543.87	545.26	539.76	4.79
00 MAX	1.81	5.94	14.81	549.97	14.57	548.36	549.71	540.21	5.24
00 AVG	1.69	5.54	11.01	546.17	11.49	545.28	546.11	540.05	4.95
98-00 MIN	1.50	4.92	10.10	545.26	10.06	543.85	545.26	538.73	3.96
98-00 MAX	3.35	11.00	15.40	550.56	15.23	549.02	550.32	541.04	6.27
98-00 AVG	1.84	6.03	11.04	546.20	11.49	545.28	546.08	539.89	5.11

Table E-2. Summary of Channel Depths at Station W-M462.5O

[1/] FAII4 463.5 Pool Elevation = FAII4 463.5 Gage Reading + Gage Zero
where Gage Zero = 535.16 feet MSL (1912)

[2/] MI16 457.2 Pool Elevation = MI16 457.2 Gage Reading + Gage Zero
where Gage Zero = 533.79 feet MSL (1912)

[3/] W-M462.5O Bottom Elevation = W-M462.5O Pool Elevation - W-M462.5O Channel Depth

[4/] W-M462.5O Flat Pool Channel Depth = Flat Pool - W-M462.5O Bottom Elevation
where Flat Pool = 545 feet MSL

APPENDIX F

TECHNICAL COMPUTATIONS

APPENDIX G

PUMP STATION INSPECTION REPORT

PUMP STATION INSPECTION REPORT

Name of Project and Program (EMP, 1135, Etc.):

Andalusia Refuge Rehabilitation and Enhancement, EMP
Pool 16, River Mile 462-463, Rock Island County, Illinois

Date/Hour Inspection Began/Ended:

Date: 11/29/00 Time: 0900

Inspectors:

Corps Representatives: Mark Clark, Rachel Fellman, John Behrens
Local Sponsor Officials: Jay Finn, ILDNR

River/Forebay Elevations:

River El.: _545.5___ Stage El.: ____N/A___ Zero Gage El.: __N/A___
Management Unit El.: _546.5___ Stage El.: ____N/A___ Zero Gage El.: ___N/A__

Project Data:

Pumping Arrangement and Configuration: Two (2) submersible KSB pumps set up for bi-directional pumping.

Size of Moist Cell Unit(s) (Acres): 130 Acres

Fill Time (Days): Actual: To raise M.SMU between EL. 546.0 to EL. 547.0 equates to 5 days of pumping.
Design: 14 days for the same Elevations.

Empty Time (Days): Actual: ILDNR lowers the MSMU to EL. 543.0
Design: EL. 542.0

General Comments:

1. Gaskets were observed to be detaching from the aluminum stoplogs.

2. A problem was experienced this fall by the pump operator while attempting to maintain the MSMU between EL. 543.0 – 543.5. The “Pump Out” pump could not be operated in the “manual” or “auto” mode. The cause of the operational flaw was not investigated nor corrected.

PUMP STATION MAINTENANCE INSPECTION GUIDE

ATED ITEM	A	M	U	EVALUATION	REMARKS
SECTION I				***FOR INTERNAL USE AND EVALUATION***	
ump Station Size	A			Pump station has adequate capacity (considering pumping capacity, ponding areas, Compare Fill/Empty times with Design, etc.). (A or U.)	
SECTION II				***FOR LOCAL SPONSOR USE***	
&M Manual	A			O&M Manual is present and adequately covers all pertinent areas. (A or U.)	Corps Operations and Maintenance Manual is dated December 1995. Recommendation: The O&M information should include a pu curve for the pumps. The pump station operators and mainten personnel should review the manuals biannually for routine maintenance to be identified and performed as recommended b equipment manufacturers. Identify such review and maintenan the operation logbook. Maintain good record keeping and perf the required maintenance as outlined in the operation and maintenance manuals.
perating Log	A			Pump Station Operating Log is present and being used. (A or U.)	Recommendation: A logbook for the pump station should be initiated. The logbook should be in a notebook, 3-ring binder bound logbook and should be in neat tabular form. Entries in logbook should indicate such items as date, water elevations, a periodic lubrication, pump hours or running time, maintenance/repairs, and special events that are significant in nature. The logbook should be stored and protected in the sar location and manner as operation and maintenance manuals. Protection provided shall be moisture and rodent proof. The lo book should also include sections for pump performance testin pump overhaul or service work performed, sump maintenance pump discharge outlet work, and forebay cleaning (dredging), Include in the log book brief descriptions of any service work o maintenance. These descriptions could possibly be located in t own section that could be separate from the daily entries if spa does not allow for it.

ATED ITEM	A	M	U	EVALUATION	REMARKS
nnual Inspection	A			Annual inspection is being performed by the local sponsor. (A or U.)	Recommendation: The local sponsor should perform routine maintenance in accordance with the operation and maintenanc manuals for the equipment. Annual inspection dates, discrepan that are found and actions taken should be entered into the logb Recommend that a written checklist be developed for the annu inspection to ensure it is performed in accordance with manufacturer's recommendations as described in the operation maintenance data.
lant Building	A			A Plant building is in good structural condition. No apparent major cracks in concrete, no subsidence, roof is not leaking, etc. Intake louvers clean, clear of debris. Exhaust fans operational and Maintained. Safe working environment. M Spalding and cracking are present, or minimal subsidence is evident, or roof leaks, or other conditions are present that need repair but do not threaten the structural integrity or stability of the building. U Any condition that does not meet at least Minimum Acceptable standard.	Four (4) 6-inch diameter ventilation holes have been installed Corps personnel to assist with building ventilation and reduce condensation. The building is concrete and is in good condition.
umps	A			A All pumps are operational. Preventive maintenance and lubrication are being performed. System is periodically subjected to Performance testing. No evidence of unusual sounds, cavitation, or vibration. M All pumps are operational and deficiencies/minor discrepancies are such that pumps could be expected to perform through the next period of usage. U One or more primary pumps are not operational, or noted discrepancies have not been corrected.	"To River Pump" operating hrs 1114.4 "To Pond Pump" operating hrs. 751.0 The operator believes the "To River Pump" hour meter register twice the number of hours on the meter compared to the actual pumping time. Each pump designed for 6,775 gpm @ 8.5 TDH. Recommendation: The reported problem with the "To River Pu run time meter should be investigated and corrected.

ATED ITEM	A	M	U	EVALUATION	REMARKS
Motors, Engines nd Gear Reducers	A			A All items are operational. Preventive maintenance and lubrication being performed. Systems are periodically subjected to performance testing. Instrumentation, alarms, and auto shutdowns operational. M All systems are operational and deficiencies/minor discrepancies are such that pumps could be expected to perform through the next Expected period of usage. U One or more primary motors are not operational, or noted discrepancies have period of usage.	Perform operation and maintenance to the pump motors in accordance with the operation and maintenance manuals. Rep lubricant with pump motors in accordance with the manufactu recommendations.
umps/Trash acks	A			**SPECIAL INSTRUCTIONS:** *Measure silt accumulation in sumps and trash racks. Measure water depth at inlet and outlet.* A Sumps/Trash Racks are free of concrete deterioration, protected from Permanent damage by corrosion and free of floating and sunken Debris. Sumps are clear of Accumulated silt. Passing debris is minimized by spacing of trash rack bars. Periodic maintenance performed on trash racks and removal of accumulated silt in sumps is performed. M Trash racks and sumps have some accumulated silt or debris but are not currently inhibiting the pump(s) performance. No periodic maintenance has been performed. Present condition could be expected to perform through the next expected period of usage provided removal of floating debris is accomplished. U Proper operation can not be ensured through the next period Of usage. Possible damage could result to the pumping equipment With continued operation.	The ILDNR has added a outer trash rack to minimize aquatic vegetation from clogging the pump station main trash rack. No excessive debris or siltation was observed. River Side- The water depth in front of the trash rack was measured to be 3 and approximately 2” of silt accumulation. The water depth be the trash rack was measured to be 6’-0”. Moist Soil Management Unit Side- The water depth behind the trash rack was measured to be 8’-0 Could not reach the front of the trash rack to measure water de Recommendation: Dates of any maintenance or cleaning performed should be logged into the operation logbook.
ther Metallic Items	A			A All metal parts in plant/building are protected from permanent damage by corrosion. Equipment anchors and grout pads show no rust or deterioration. M Corrosion on metallic parts (except equipment anchors) and deterioration period of usage. U Any condition that does not meet at least Minimum Acceptable standards.	

ATED ITEM	A	M	U	EVALUATION	REMARKS
Ancillary Equipment Compressed Air Siphon Breakers Fuel Supply Vacuum Priming Pump Lubrication eating/Ventilation Engine Cooling ngine Oil Filtering	A			A All equipment operational. Preventive and annual maintenance being performed. Equipment operation understood and followed by pump station operators. M Ancillary equipment is operational and deficiencies/minor discrepancies are such that equipment could be expected to perform through the next period of usage. U One or more of the equipment systems is inoperable. The present condition of the inoperable equipment could reduce the efficiency of the pump station or jeopardize the pump station's role in flood protection.	Not Applicable
Backup Ancillary Equipment	A			A Adequate, reliable, and enough capacity to meet demands. Backup units/equipment are properly sized, operational, periodically exercised, and in an overall well maintained condition. M Backup ancillary equipment is operational and deficiencies/minor discrepancies are such that equipment could be expected to perform through the next period of usage. U Backup ancillary equipment not considered reliable to sustain operations during flooding conditions.	Not Applicable
Pump Control System		M		A Operational and maintained free of damage, corrosion, or other debris. M Operational with minor discrepancies. U Not operational, or uncorrected discrepancies noted from previous inspections.	Corps personnel have completed float guard modifications. Pump operator reported a problem with the " To River" pump w ILDNR were trying to maintain the MSMU between EL. 543.0 543.5. The pump could not be operated in either "manual" or "auto" mode while the MSMU was at the identified elevations. Recommendation: ILDNR should investigate the cause of the suspected float malfunction and correct the problem to allow fu range pumping. New pump station personnel should be thorou trained the correct operation and maintenance procedures for a pump station electrical and mechanical equipment.

ATED ITEM	A	M	U	EVALUATION	REMARKS
Intake and Discharge Outlets	A			Functional. No damaging erosion evident. Opening/closing devices for vertical gates, flap gates, etc. are functional in a well-maintained condition. (A or U.)	Gaskets were observed to be detaching from the aluminum stoplogs. Recommendation: Gaskets should be reattached to stoplogs.
Insulation Megger Testing pump stations Electric pumps)		M		A Megger test has been performed within the last 36 months. Results of megger test show that insulation of primary conductors and electric motor meet manufacturer's or industry standard. M Results of megger test show that insulation resistance is lower than manufacturer or industry standard, but can be expected to perform satisfactorily until next testing or can be corrected. U Insulation resistance is low enough to cause the equipment to not be able to meet its design standard of operation.	No megger testing has been performed. Recommendation: The ILDNR should perform megger testing the electric pump motors periodically.
Final Remarks					

APPENDIX H

LEVEE INSPECTION REPORT

LEVEE INSPECTION REPORT

1. Name of Flood Control Works:
   Andalusia Refuge Habitat Rehabilitation and Enhancement Project (HREP)

2. Date/Hour Inspection Began/Ended:
   29 November 2001 - 0900 / 1100

3. Inspectors (Including Levee Officials):
   Corps Representative(s) - Mark Clark, John Behrens, and Rachel Fellman
   Sponsor Representative(s) - Jay Finn (ILDNR Site Manager)

4. Inspection Procedures Followed:
   Drove the entire levee system

5. Evaluation of Flood Control Works:
   Acceptable

6. General Comments:
   Overall maintenance of levee system acceptable, however tree removal required along toe of levee L/S from Sta. 16+75 to Sta. 29+80 to allow for adequate access

Inspector's observations and comments as follows:

RATING	ITEM	LOCATION Sta. to Sta.	REMARKS Note: R/S - Riverside L/S - Landside
	LEVEE SLOPES		
A	Depressions		
A	Erosion		
A	Slope Stability		
A	Cracking		
	Seepage Areas *(Do not rate. Note areas that are of concern during high water.)*		
A	Animal Burrows		

RATING	ITEM	LOCATION Sta. to Sta.	REMARKS Note: R/S - Riverside L/S - Landside
A	Unwanted Levee Growth		
A	Grazing		
A	Sod		
MA	Encroachments	Sta. 16+75 to Sta. 29+80	L/S of levee – tree encroachment at toe of levee, suggest a 10 foot buffer between toe and trees
	LEVEE CROWN		
	Authorized Levee Access Gates *(Do not rate. List gate locations.)*		
A	Depressions		
A	Erosion		
A	Cracking		
A	Animal Burrows		
A	Unwanted Levee Growth		
A	Grazing		
A	Sod		
A	Road Crossings *(other than those with closure structures)*		
A	Encroachments		
	REVETTED AREAS		
A	Riprap/Revetment		

RATING	ITEM	LOCATION Sta. to Sta.	REMARKS Note: R/S - Riverside L/S - Landside
A	Unwanted Levee Growth		
A	Encroachments		
	FLOOD WALLS		
A	Stability of Concrete Structures		
A	Concrete Surfaces		
A	Structural Foundations		
	DRAINAGE STRUCTURE(S)		
	Toe Drains *(Do not rate. List stationing and locations of drains.)*		
N/A	Relief Wells		
A	Culverts		
A	Riprap/Revetment		
A	Stability of Concrete Structures		
A	Concrete Surfaces		
A	Structural Foundations		
A	Gates		
	CHANNELS		
A	Unwanted Levee Growth		
A	Stability of Concrete Structures		

RATING	ITEM	LOCATION Sta. to Sta.	REMARKS Note: R/S - Riverside L/S - Landside
A	Concrete Surfaces		
A	Structural Foundations		
A	CLOSURE STRUCTURE(S)		
	PUMP STATION(S) *(See "Pump Station Inspection Report" in Appendix G.)*		

APPENDIX I

PHOTOGRAPHS OF PROJECT FEATURES

APPENDIX J

PROJECT TEAM MEMBERS

ANDALUSIA REFUGE PROJECT TEAM MEMBERS

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ble H-1. Andalusia Refuge Project Team Members

APPENDIX K

REFERENCES

REFERENCES

Published reports relating to the Andalusia Refuge project or which were used as references in the production of this document are presented below.

(1) *Definite Project Report with Integrated Environmental Assessment (R-5), Andalusia Refuge Rehabilitation and Enhancement, Upper Mississippi River System Environmental Management Program, Pool 16, Upper Mississippi River, Rock Island County, Illinois, July 1989*. The report marks the conclusion of the planning process and serves as a basis for approval of the preparation of final plans and specifications and subsequent project construction.

(2) *Plans and Specifications, Upper Mississippi River System, Environmental Management Program, Pool 16, River Miles 462.0 - 463.0, Andalusia Refuge,* Solicitation No. DACW25-90-B-0031. These documents were prepared to provide sufficient detail of project features to allow construction of a confined dredged material placement site, hydraulically dredged channels, mechanically excavated channels, potholes, and check dams.

(3) *Plans and Specifications, Upper Mississippi River System, Environmental Management Program, Pool 16, River Miles 462.0-463.0, Andalusia Refuge,* Contract No. DACW25-93-C-0034. This document was prepared to provide sufficient detail of project features to allow planting of mast trees.

(4) *Operation and Maintenance Manual, Andalusia Refuge Rehabilitation and Enhancement, Upper Mississippi River Environmental Management Program, Pool 16, River Mile 462.0 – 463.0, Rock Island County, Illinois, June 1994*. This manual was prepared to serve as a guide for the operation and maintenance of the Andalusia Refuge project. Operation and maintenance instructions for major features of the project are presented.

(5) *Post-Construction Performance Evaluation Report (PER5F), Andalusia Refuge Rehabilitation and Enhancement, Upper Mississippi River System Environmental Management Program, Pool 16, Upper Mississippi River Mile 462.0 – 463.0, Rock Island County, Illinois, February 1996.*

(6) *Post-Construction Supplemental Performance Evaluation Report (SPER501F), Andalusia Refuge Rehabilitation and Enhancement, Upper Mississippi River System Environmental Management Program, Pool 16, Mississippi River Miles 462.0 – 463.0, Rock Island County, Illinois, August 1998.*

(7) *Site Manager's Project Inspection and Monitoring Results, Andalusia Refuge Rehabilitation and Enhancement, Operation and Maintenance Manual, Upper Mississippi River Environmental Management Program, Pool 16, River Miles 462 through 463, Rock Island, Illinois*, July 1996, August 1997, June 1998, July 1999, September 2000.

APPENDIX L

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APPENDIX M

PLATES